A COMPARATIVE STUDY ON THE EFFECTIVENESS OF AEROBIC EXERCISE WITH CONVENTIONAL THERAPY ON IMPROVING FUNCTIONAL ABILITIES IN EARLY OSTEOARTHRITIC KNEE

Dissertation work submitted to

THE TAMIL NADU DR. M. G. R. MEDICAL UNIVERSITY,

Chennai-32

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Degree programme

Submitted by

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THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY,

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Dissertation work evaluated on ----------

Internal Examiner **External Examiner**

CERTIFICATE- I

This is to certify that the dissertation work entitled **"A COMPARATIVE STUDY ON THE EFFECTIVENESS OF AEROBIC EXERCISE WITH CONVENTIONAL THERAPY ON IMPROVING FUNCTIONAL ABILITIES IN EARLY OSTEOARTHRITIC KNEE"** was carried out by **Reg. No. 27092304** of P.P.G College of physiotherapy Coimbatore-35, affiliated to the Tamilnadu Dr. M.G.R. Medical University, Chennai-32, under the guidance of **Prof. S. CHERALATHAN M.P.T (Ortho), MIAP.,**

Prof. K. RAJA SENTHIL M.P.T (Cardio-Resp),MIAP.,Ph.d
Principal

CERTIFICATE - II

This is to certify that the dissertation work entitled **"A COMPARATIVE STUDY ON THE EFFECTIVENESS OF AEROBIC EXERCISE WITH CONVENTIONAL THERAPY ON IMPROVING FUNCTIONAL ABILITIES IN EARLY OSTEOARTHRITIC KNEE"** was carried out by **Reg. No. 27092304** of P.P.G College of physiotherapy, Coimbatore-35, affiliated to the Tamilnadu Dr. M.G.R medical university, Chennai-32, under my guidance and direct supervision.

Prof. S. CHERALATHAN M.P.T (Ortho), MIAP.
Guide

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A COMPARATIVE STUDY ON THE EFFECTIVENESS OF AEROBIC EXERCISE WITH CONVENTIONAL THERAPY ON IMPROVING FUNCTIONAL ABILITIES IN EARLY OSTEOARTHRITIC KNEE

ABSTRACT

Study objectives: To find out the effectiveness of aerobic exercise with conventional therapy on improving functional abilities in early osteoarthritic knee.

Participants: 30 subjects with early osteoarthritis knee were selected. They were divided into control group and experimental group with 15 patients in each group**.**

Outcome measures: WOMAC scale is used to measure the functional abilities before and after the treatment.

Results: Statistical analysis can be done by using paired‘t’ test shows improvement of functional abilities.

Conclusion: It can be concluded from this study that aerobic exercise with conventional therapy shows significant improvement in the functional abilities in patients with early osteoarthritic knee.

Key words: Osteoarthritis, WOMAC scale, Ultrasound therapy, Isometric exercise, Aerobic exercise.

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INTRODUCTION

Osteoarthritis was earlier described as a disease of wear and tear, a degenerative disorder, but, recent advances show that it represents a dynamic process, which involves uncoupling of balance between cartilage degeneration and regeneration. 0steoarthritis usually presents as joint pain with structural changes, crepitus, bony enlargements, deformity, instability and restriction of movements. Associated muscular weakness and wasting may also occur. Morning stiffness is a common complaint but brief in duration, usually lasts for 5-15 minutes but not exceeding 30 minutes.

A. Graham Apleys(1993) defines osteoarthritis as a chronic joint disorder in which there is progressive softening and disintegration of articular cartilage accompanied by new growth of cartilage and bones at the joint margins (osteophytes) and capsular fibrosis. These changes result from a variety of abnormalities that predisposes to mechanical failure of the hyaline cartilage.

A.V.Kulkarni (1999) stated that osteoarthritis of knee is much more common in India because of the life style of cross-legged sitting and squatting. Hyaline cartilage gets degenerated and eroded in osteoarthritis. Since the cartilage is devoid of innervations, any injury to it will not be appreciated until there is a synovial reaction. Since the synovium is innervated it transmits nociception.

Early osteoarthritis tends to occur commonly between the age group of 30-50 years. The symptoms are usually characterized by pain and stiffness. The stiffness tends to follow periods of inactivity; morning stiffness dissipates within 30 minutes of walking. Crunching feeling or crackling sound also may occur when the joint is used.

Rene Calliet (1992) stated that pain can also be experienced when the cartilage undergoes sufficient degeneration to expose the underlying bone which is also innervated and transmits pain. Cartilage becomes thinner due to friction and develops osteophytes, which are irregular bony outgrowth that leads to stiffness of joints.

The major role of exercises is development, enhancement or maintenance of the strength of muscles and relief of pain.

Common types of exercises encountered for osteoarthritis are stretching, strengthening, isometric and aerobic exercises.

The isometric exercises commonly used involve muscle contraction in which there is no shortening or lengthening of the muscle. Due to its effect of reduction in intramuscular friction, it reduces the pain. The isometric effect on quadriceps and hamstrings given alternatively reduces pain thereby improving functional ability.

Ultrasound is a therapeutic modality that has been used by physical therapists for many years. Ultrasound is applied using a round-headed wand or probe that is put in direct contact with the patient's skin. Ultrasound gel is used on all surfaces of the head in order to reduce friction and assist in the transmission of the ultrasonic waves. Therapeutic ultrasound is in the frequency range of about 0.8-3.0 MHz.

The waves are generated by a piezoelectric effect caused by the vibration of crystals within the head of the wand/probe. The sound waves that pass through the skin cause a vibration of the local tissues. This vibration or cavitations can cause a deep heating locally though usually no sensation of heat will be felt by the patient. In situations

where a heating effect is not desirable, such as a fresh injury with acute inflammation, the ultrasound can be pulsed rather than continuously transmitted.

The home exercise programme is simple to use and applicable for all age groups. It was designed to maintain and improve the strength of muscles acting around the knee, the range of motion at the knee joint and loco motor function. The programme is self paced but become progressively more challenging.

Current literatures shows that aerobic exercises has greater effects on various systems of the body namely cardiovascular system, musculoskeletal system, metabolic system and psychologically. The aerobic exercise helps in thickening of cartilage, increase in overall muscle strength, and increase in muscle endurance there by slowing down the rate of joint degeneration which helps the early osteoarthritic patients to perform the day to day activities efficiently without much discomfort.

NEED FOR THE STUDY

Osteoarthritis is one of the most crippling degenerative disorder, if untreated may result in permanent disability. Wide range of physiotherapy modalities like interferential therapy, shortwave diathermy, wax bath, TENS along with mobilization and muscle power strengthening exercises plays vital role in minimizing the disability.

Only few studies are available regarding to prove the effectiveness of aerobic exercises with conventional therapy like ultrasound therapy, isometric exercises and home based exercise programme on improving functional abilities in early osteoarthritic knee. So there is a need to further support the efficacy of effectiveness of aerobic exercises with conventional therapy like ultrasound therapy, isometric exercises and home based exercises on improving functional abilities in early osteoarthritic knee.

OPERATIONAL DEFINITIONS

OSTEOARTHRITIS

Osteoarthritis (OA) refers to a clinical syndrome of joint pain accompanied by varying degrees of functional limitation and reduced quality of life. It is by far the most common form of arthritis and one of the leading causes of pain and disability worldwide.

Altman RD, Asch E, Bloch D et al. (1986)

AEROBIC EXERCISE

Aerobic exercise is physical exercise that intends to improve the oxygen system, aerobic means "with oxygen", and refers to the use of oxygen in the body's metabolic or energy-generating process. Many types of exercise are aerobic, and by definition are performed at moderate levels of intensity for extended periods of time.

Kenneth H. cooper, Col.Pauline potts (1968)

ISOMETRIC EXERCISE

Isometric exercise is a static form of exercise that occurs when a muscle contracts without an appreciating change in the length of the muscle or without visible joint motion.

Carolyn Kisner Lynn Allen Colby (1996)

WOMAC SCALE

The **Western Ontario and McMaster Universities Arthritis Index** (**WOMAC**) is a set of standardized questionnaires used by health professionals to evaluate the condition of patients with osteoarthritis of the knee and hip. It can be self-administered

and was developed at Western Ontario and McMaster Universities. It assesses the pain, joint stiffness, physical, social and emotional function of a person with osteoarthritis in determining the overall level of disability.

William McMaster (1830)

ULTRA SOUND THERAPY

Therapeutic ultrasound in physical therapy is alternating compression and rarefaction of sound waves with a frequency of >20,000 cycles/second. Therapeutic ultrasound frequency used is 0.7 to 3.3 MHz Maximum energy absorption in soft tissue is 2 to 5 cm. Intensity decreases as the waves penetrate deeper. They are absorbed primarily by connective tissue: ligaments, tendons, and fascia (and also by scar tissue)

Watson, T. (2006)

AIM OF THE STUDY

- To find out the effectiveness of aerobic exercises with conventional therapy on improving functional abilities in early osteoarthritic knee.

OBJECTIVES OF THE STUDY

- To find out the effectiveness of conventional therapy like ultrasound therapy, isometric exercises and home based exercise programme on improving functional abilities in early osteoarthritic knee
- To find out the effectiveness of aerobic exercises with conventional therapy like ultrasound therapy, isometric exercises and home based exercise programme on improving functional abilities in early osteoarthritic knee.
- To compare the effectiveness of aerobic exercises with conventional therapy like ultrasound therapy, isometric exercises and home based exercise programme on improving functional abilities in early osteoarthritic knee.

HYPOTHESIS

NULL HYPOTHESIS

There is no significant difference exists between aerobic exercises and conventional therapy in improving functional abilities on early osteoarthric knee.

ALTERNATE HYPOTHESIS:

There is significant difference exists between aerobic exercises and conventional therapy in improving functional abilities on early osteoarthric knee.

REVIEW OF LITERATURE

- **Rutjes AWS, Nuesch E, Sterchi R, Juni P. et al., (2009)**

They suggest that therapeutic ultrasound may be beneficial for patients with osteoarthritis of the knee. Because of the low quality of the evidence, we are uncertain about the magnitude of the effects on pain relief and function, however. Therapeutic ultrasound is widely used for its potential benefits on both knee pain and function, which may be clinically relevant. Appropriately designed trials of adequate power are therefore warranted.

- **Bischoff HA, Roos EM.et al., (2003)**

Stated aerobic exercise seems to be equally effective in regard to pain and function in patients with OA. In obese patients with OA, a combination of diet and exercise may be advantageous for optimal benefits I health related quality of life and physical function.

- **Stensdotter AK, Hodges PW, Mellor R, Sundelin G, Hager-Ross C.et al., (2003)**

Stated exercise in closed kinetic chain promotes more balanced initial quadriceps activation than does exercise in open kinetic chain.

- **French DN, Kraemer WJ, Cooke CB. et al., (2003)**

Stated that performing a sequence of repeated maximal isometric knee extensions (3 repetitions of 3 seconds) prior to selected dynamic exercise may have favorable effects on performance beyond standards achieved without prior heavy loading.

- **Jonders I, Stewert C, Spaepen A. et al., (2003)**

Stated that maintenance of stance limb stability requires a subtle interplay of muscle activations. Weakness in a single muscle is unlikely to be adequately compensated for by increasing or decreasing the activation of one muscle alone.

- **Dr. Micheal Olpin et al., (2003)**

Stated musculoskeletal benefits include increasing the thickness of cartilage in the joints, increasing the strength of connective tissue such as ligaments and tendons, increases overall muscle strength increases overall muscle endurance maintains and increases muscle and joint degeneration, increases bone density.

- **Brosseau L, Macleay L, Robinson V. Wells G, Tugwell P.et al., (2003)**

Stated both high intensity and low intensity aerobic exercise appear to be equally effective in improving a patient's functional status, gait, pain and aerobic capacity for people with OA of the knee.

- **Roos E. et al., (2002)**

Stated aerobic exercises have positive effects on pain and function. The minimum recommendations of exercise and equivalent to the recommendations of physical activity to obtain or maintain a good general health.

- **Pennix BW, Rejeski WJ, Pandya J, Miller ME, Di Bari M, Applegate WB, Pahor M. et al., (2002)**

Stated that reduction in depressive symptoms with aerobic exercise with initially high depressive symptomology.

- **Cheing GL, hui- chan CW, chan km.et al.,(2002)**

Stated isometric exercise training five days four weeks reduced knee pain towards the end of the treatment period.

- **Kubo k, kanehisa h, ito m, fukunaga t. et al., (2001)**

Stated isometric training increases the stiffness and young's modulus of human structures as well as muscle strength and size This change in the tendon would be assumed to be an advantage for increasing the rate of torque developed and shortening the electromechanical delay.

- **Kishore K et al., (2001)**

Concluded that pain becomes the main focus of the therapeutic management arthritis. A regular low-impact exercise of OA joints doesn't increase the development of OA.

- **Neptune RR, Kautz SA, Zajic FE. et al (2001)**

Stated in this study examining individual contributions of the ankle plantar flexors to the body segment energetic using a musculoskeletal model and generate a forward dynamics simulation of normal walking at 1.5 m/s. throughout single –leg stance both SOL and GAS provide vertical support, in mid single-leg stance SOL and GAS have opposite energetic effects on the leg and trunk to ensure support and forward progression of both the leg and trunk, and in pre-swing only GAS contributes to swing initiation.

- **Sheila O' Reilly et al.,(1997)**

In their study concluded that isometric exercise had significant decrease in pain

- **Hurwitz DE, Ryals AR, Block JA, Sharma L, Schnitzer TJ, Andriacchi TP et al., (2000)**

Stated that decrease in pain among patients with medical tibiofemoral osteoarthritis to increased loading of the degenerative portion of the joints.

- **Saito T. Koshino T et al., (2000)**

Stated substance p and calcitonin generated peptide were found more frequently in the medial than in the lateral or supra patellar areas. Substance p positive free nerve endings showed more dendritic morphologic features in the medial region than did those in the lateral and supra patellar regions and small nerves in the medial region; the synovitis was more remarkable than in the lateral region.

- **Robertson and Baker et al.,(1999)**

Examined 35 randomized controlled trials, the reviewers reported finding little evidence that active therapeutic US was more effective than placebo US in treating people with pain or a range of musculoskeletal injuries or in promoting soft tissue healing

- **Roland et al., (1998)**

Stated that OA has an insidious onset and the cardinal symptom of disease is pain during functional activity and is relieved by rest in early stage.

- **Huskisson EC et al., (1997)**

Stated that there are more sensitive tools than other measures to changes in pain intensity.

- **Borjesson M, Robertson E, Weidenhielm L, Mattsson E, Olsson E. et al., (1996)**

Stated walking three times a week for five weeks in patients who experienced a feeling of overall improvement in the knee and ability of descending steps improved. These improvements are beneficial to the patients and support the positive effects of exercise and activity.

- **Carolyn kisner Lynn Allen Colby et al.,(1996)**

Isometric exercise is a static form of exercise that occurs when a muscle contracts without an appreciating change in the length of the muscle or without visible joint motion.

- **Neuberger GB, Kasal S, Smith KV, Hassanein R, DeViney S. et al., (1994)**

Stated that perceived benefits of exercise were a significant predictor of exercise participation. Subjects with less formal education, longer duration of arthritis, and higher impact of arthritis scores perceived fewer benefits of exercise, while subjects who reported exercising in their youth perceived more benefits of exercise.

MATERIALS AND METHODOLOGY

MATERIALS

- Treadmill
- Ultrasound therapy unit
- Aqua sonic gel
- Pillows
- Towels
- WOMAC index chart
- Chair
- Couch

METHODOLOGY

STUDY DESIGN

- Experimental study design with pre-test and post-test.

SAMPLING TECHNIQUE

- Purposive sampling technique.

SAMPLE SIZE

- Study sample consists of 30 subjects.

STUDY METHOD

- Subjects were divided into control group and Experimental group.

CONTROL GROUP

- 15 subjects were treated with conventional therapy(ultrasound therapy, isometric exercises and home programe exercises).

EXPERIMENTAL GROUP

- 15 subjects were treated with aerobic exercise and conventional therapy (ultrasound therapy, isometric exercises and home programe exercises).

SELECTION CRITERIA

INCLUSION CRITERIA

- Age 35-50 yrs
- Gender : both male and female
- Current symptoms of pain and stiffness (6 month) during weight bearing activities.
- Early morning stiffness subsiding with inn 30 minutes on activity.

EXCLUSION CRITERIA

- Current participation in a regular exercise program
- Existing medical problem that would preclude increased physical activity.
- Subjective complaint of instability
- Ligamentous instability.
- Knee flexion Contracture
- Inflammatory arthritis
- Major reconstructive surgery on lower extremity joint.
- Multiple major joint involvements.
- Foot problem

- Deformities of lower limb
- Conditions such as stroke

STUDY SETTING

- Aswin multispecialty hospital, Coimbatore.
- Bone and joint hospital, Coimbatore.

PERIOD OF STUDY

- Three months

MEASUREMENT PARAMETER

- **WOMAC** index [Western Ontario And Mc Master University Scale]

STATISTICAL TOOLS

In this study‘t’ test is used to analyze the result. The intra group analysis was done using paired ‘ t’ test.

Paired ‘t’test

$$t = \frac{\overline{d}\sqrt{n}}{s}$$

$$s = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

d - Means of deviation

n - Total member of subjects

s - Standard deviation

$\sum d^2$ - sum of squared deviation

Unpaired t- test

Unpaired t- test to assess the changes between the groups.

$$t = \frac{\overline{X}_1 - \overline{X}_2}{S} \sqrt{\frac{N_1 N_2}{N_1 + N_2}}$$

$$S = \sqrt{\frac{\sum\left(x1 - \bar{x1}\right)^2 + \sum\left(x2 - \bar{x2}\right)^2}{n1 + n2 - 2}}$$

X_1 - mean of control group.

X_2 - mean of experimental group.

N_1 – number of subjects in control group.

N_2 – number of subjects in experimental group.

S - Standard deviation

TREATMENT TECHNIQUES

CONTROL GROUP

1) ULTRA SOUND THERAPY

Dose : 0.8 to 1.2w.cm^2

Mode : pulsed

Pulse ratio : 1 : 2

Duration : 10 minutes

2) ISOMETRIC KNEE EXERCISES

1. Quadriceps set:

The patient is asked to sit on a chair or lie down with the knee straight on a couch by tightening the muscles on top of thigh by straightening the knee as much as the patient can. Then the patient places his/her hand on top of the thigh to feel the muscles tighten. The tightness of the muscle has to be hold for the count of 5. The procedure is repeated for 5-10 times.

2. Straight leg rise:

In this procedure the patient lies flat on back on the bed or on a floor, by bending one knee and placing foot flat on the bed.[this helps to stabilize the pelvis and protects the lower back] straightens the other knee. By tightening the muscle on the top of the thigh of the straight leg and slowly raises the entire leg 12-18 inches off the bed then slowly lowers the leg and relaxes. This exercise should only be done if the

patient can keep the back pressed against the bed with abdominal muscles gently tightened, repeated for 10 times. This is isometric at knee not at hip.

3. Short arc quadriceps:

This type of exercise is often well tolerated when the knee is painful because the knee is exercised only in small part of its range of motion. The patient lies on back and put a rolled up towel bolster measuring 3-6 inches diameter under the knee, straightens the knee. When the patient can feel the knee pushing down into the bolster as the heel lifts up and the quadriceps muscle in front of the thigh tightens. Repeated 10 times.

4. Hamstrings set:

The patient lies on back resting the heel on the bed, or sitting at the edge of the chair, resting the heel on the floor. Then the patient bends the knee slightly and digs his/her heel down into the bed or the floor squeezing it towards the patient, but not allowing it to move. The patient should be able to feel the muscles at the back of the thigh tightening. Repeated for 5-10 times.

5. Seated combination quadriceps/hamstring set:

In this procedure the patient is seated in the chair, crossing his/her ankle over the left, the left foot is flat on the floor. By pushing back with the right ankle against the left, the patient can feel the muscle on the back of the right thigh tighten, adds a forward press with the left ankle against the right and the patient can feel the muscle on the top of the left thigh tighten as well. The procedure is repeated for 10 times.

3) HOME PROGRAME EXERCISES

The patients were taught the above said isometric exercises to be done initially, later which had included progressive resisted exercises using sand bags and elastic bands. Which was self paced and advised depends upon the patients requirements.

EXPERIMENTAL GROUP

AEROBIC EXERCISE

In this aerobic exercise programme the patients were asked to walk for 30 minutes on a treadmill for 3 days in a week for 5 weeks at a normal walking speed of 3km/hr.

In addition to the aerobic exercise programme the patients were given ultrasound therapy, isometric exercises and to continue the home programe exercises.

PROCEDURE

After getting informed consent 30 subjects were selected using purposive sampling techniques and assigned into two groups as controlled group and experimental group.

The subjects of control group were given conventional physiotherapy treatments like ultrasound therapy, isometric exercises and home based exercise programme and the experimental group were given aerobic exercise in addition with the conventional therapy. Functional abilities were measured by using WOMAC scale index chart. Pre test and post test data were collected, tabulated, analyzed using‘t’ test and tested for significance.

DATA PRESENTATION

TABLE : 1

Pre test and post test value of WOMAC scale score for control group and experimental group.

S. no	**Controlled group** [conventional therapy]		**Experimental group** [conventional therapy with aerobic exercise]	
	Pre test	Post test	Pre test	Post test
01	34	30	36	27
02	35	30	34	26
03	38	32	37	28
04	40	34	38	31
05	42	35	32	25
06	30	25	28	20
07	28	22	41	30
08	30	22	35	26
09	35	29	37	28
10	37	30	42	35
11	40	34	34	26
12	46	38	37	29
13	34	28	33	28
14	28	20	40	29
15	30	26	34	26

DATA ANALYSIS AND INTERPRETATION

TABLE –II

ANALYSIS OF PRE-TEST AND POST-TEST DATA OF WOMAC SCALE SCORE FOR CONTROL GROUP

GROUPS	CONVENTIONAL THERAPY	
Control group	Pre test mean value	Post test mean value
	35.13	29.00
Paired 't' test	16.42	
P value and its significance	P value < 0.05 is significant	

For 14 degrees of freedom at 5% level of significance, the student 't' test value for control group (conventional therapy) was 16.42 and the critical value was 1.761, which states that there exists significant difference between the pre test and post test values of control group.

GRAPH I

ANALYSIS OF PRE-TEST AND POST-TEST DATA OF WOMAC SCALE SCORE FOR CONTROL GROUP

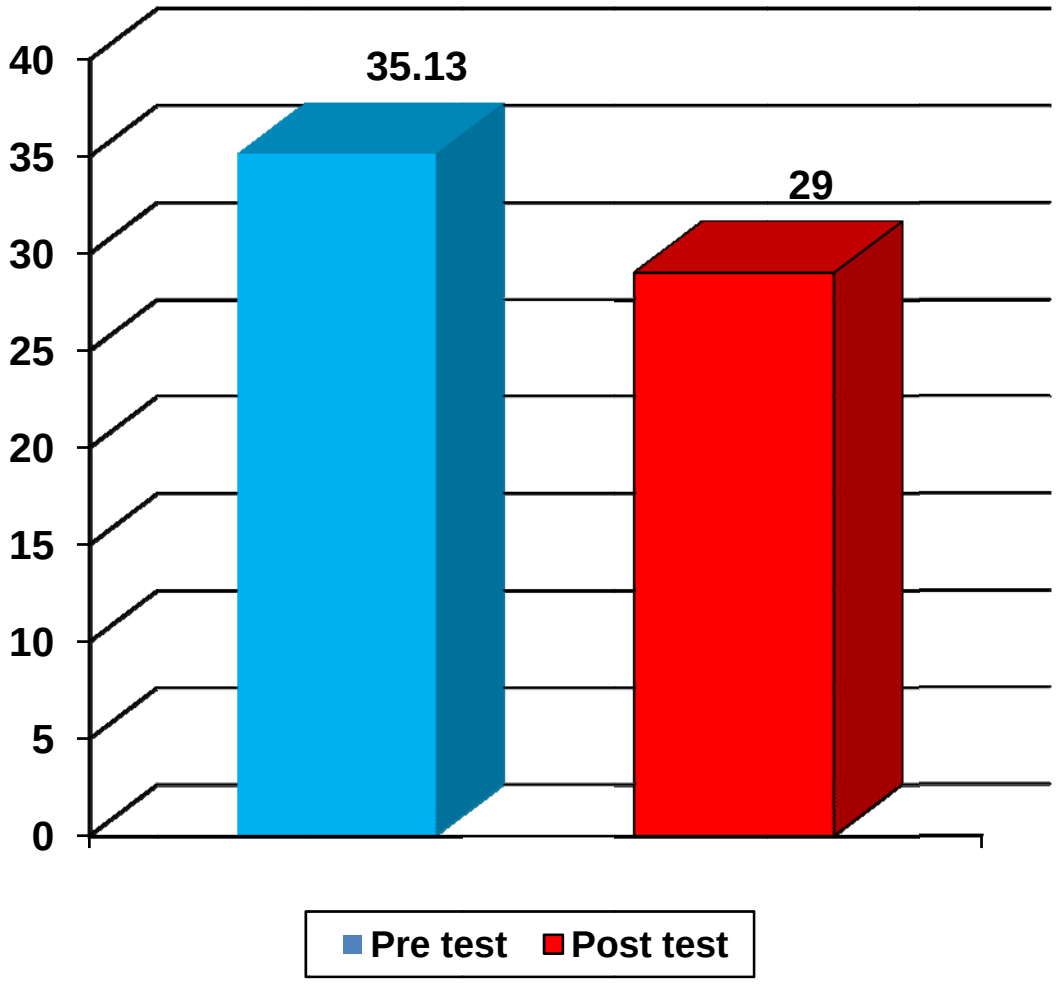


TABLE III

ANALYSIS OF PRE TEST AND POST TEST VALUES OF WOMAC SCALE SCORE FOR EXPERIMENTAL GROUP

GROUPS	**AEROBIC EXERCISE AND CONVENTIONAL THERAPY**	
Experimental group	Pre test mean value	Post test mean value
	35.86	27.66
Paired 't' test	20.89	
P value and its significance	P value < 0.05 is significant	

For 14 degrees of freedom and at 0.05 level of significance, the critical value is 1.761 and the calculated value is 20.89, since the calculated value is more than the critical value, there exists a significant difference between pre test and post test value of experimental group.

Graph II

ANALYSIS OF PRE TEST AND POST TEST VALUES OF WOMAC SCALE SCORE FOR EXPERIMENTAL GROUP

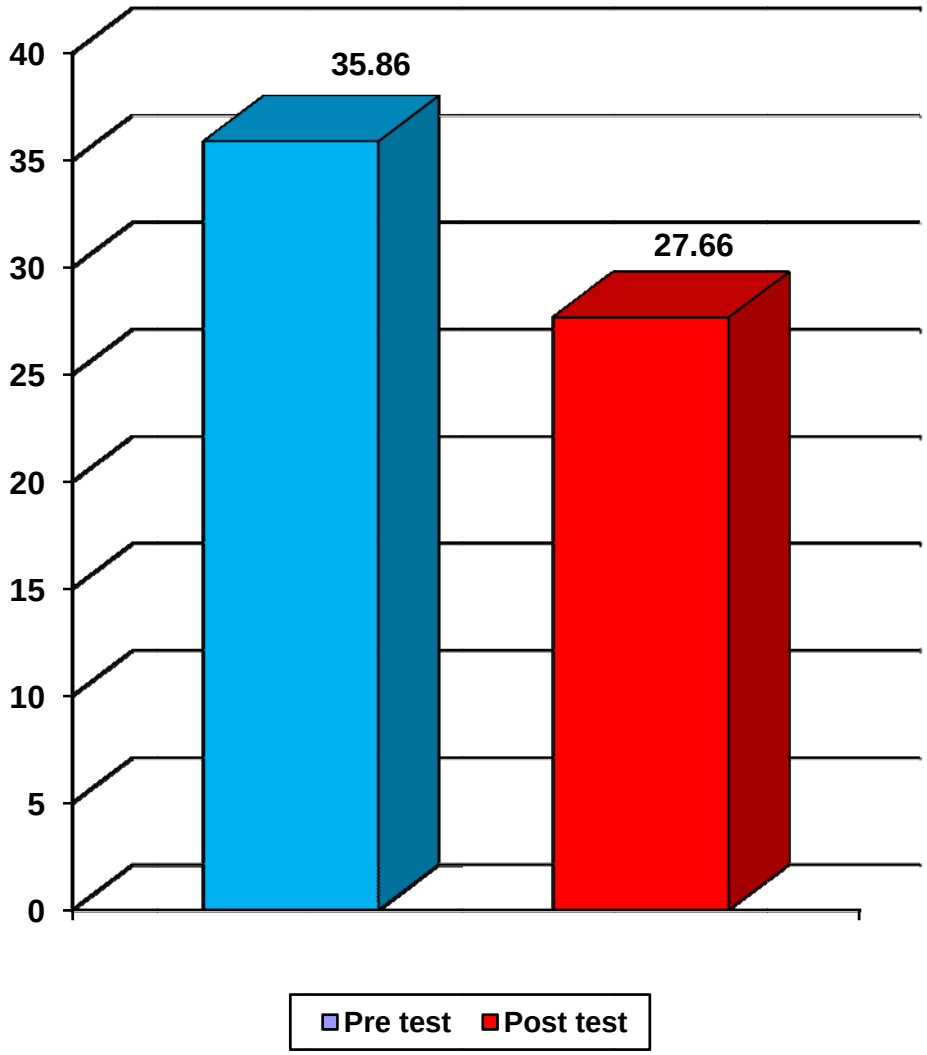


TABLE IV

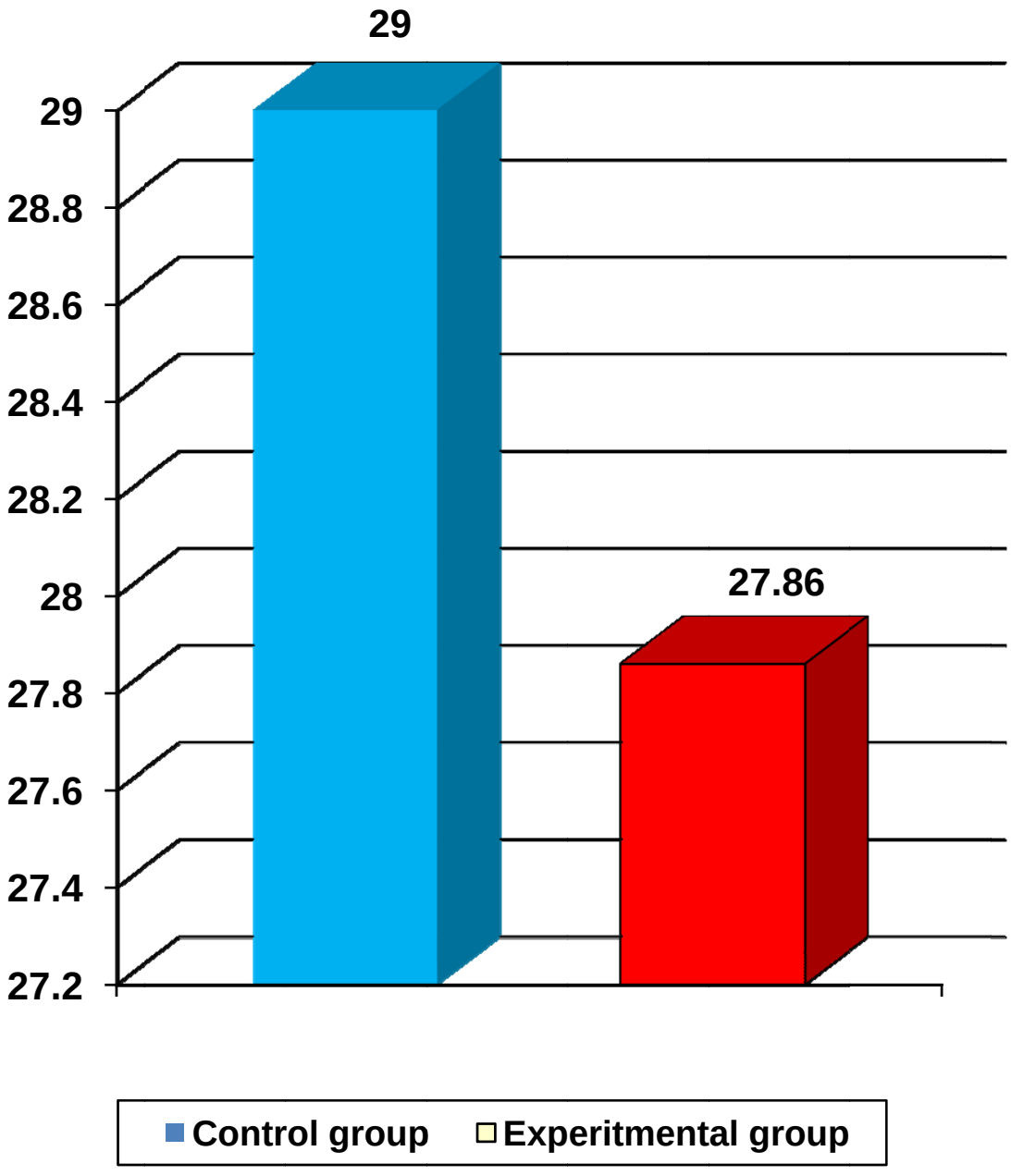
ANALYSIS OF POST TEST VALUE OF CONTROL GROUP AND EXPERIMENTAL GROUP

TESTS	**CONVENTIONAL THERAPY AND AEROBIC EXERCISE WITH CONVENTIONAL THERAPY**	
Post test mean value	Control Group	Experimental Group
	29.00	27.66
Un paired 't' test	4.39	
P value and its significance	P value < 0.05 is significant	

For 28 degrees of freedom at 5% level of significance, the calculated post test 't' value between control group and Experimental group was 4.39 and the critical value was 1.701, which states that there is significant difference between two groups.

Graph III

ANALYSIS OF POST TEST VALUE OF WOMAC SCALE SCORE FOR CONTROL GROUP AND EXPERIMENTAL GROUP



RESULTS

Effectiveness of control group is elicited comparing the pre test and post test values of control group using paired‘t’ test, the calculated value is 16.42, whereas the critical value is 1.761. Since the calculated value is greater than the critical value, there exists a significant difference between the pretest and post test values of control group. When comparing the mean values of both, the post test mean value 29.00 is lesser than the pre test mean value 35.13 which confirms that there is a significant improvement in the functional abilities on early osteoarthritis knee.

Effectiveness of Experimental group is elicited by comparing the pretest and post test values of experimental group using paired ‘t’ test, the calculated value is 20.89, whereas the critical value is 1.761. Since the calculated value is greater than the critical value, there exists a significant difference between the pretest and post test values of Experimental group. When comparing the mean values of both, the post test mean value 27.66 is lesser than the pre test mean value 35.86, which confirms that there is a significant improvement in the functional abilities on early osteoarthritis knee.

While comparing the post test value of control group and experimental group subjects using unpaired‘t’ test is 4.39 whereas the critical value is 1.761. Since the calculated value is more than the critical value, it states that there is significant difference between the post values of both control group and experimental group. Hence it confirms that there is a significant improvement in post test value of experimental group than the post test value of control group. Hence the alternative hypothesis is accepted.

DISCUSSION

This study has focused on the effects of aerobic exercise along with other conventional treatments like ultrasound therapy, isometric exercises and home based exercise programme on early osteoarthritic knee.

Moskowitz (2004) states that osteoarthritis of the knee is common, increasing with age in both women and men but are more prevalent in women following 4th decade. Osteoarthritis represents an imbalance in the destructive and synthetic processes at cartilage due to excessive loading which leads to erosion at the cartilage. In addition there is a decreased concentration and viscosity at the synovial fluid in osteoarthritic patients. These changes address both the symptoms of pain and loss of mobility.

Appropriately strengthened muscles may help to minimize the adverse effects of weight bearing on the joints by reducing the amount of force that is transmitted across the affected joints. It has been shown that weak quadriceps muscles are common in people experiencing symptoms of osteoarthritis at the knee. In addition, studies have shown that when these patients strengthen their quadriceps muscles significant improvements in pain and function are seen when compared with those who did not strengthen these muscles.

Miyaguch et al developed an isometric exercises program and analyzed the increase in the biochemical properties at joint fluid and pain relief resulting from isometric Quadriceps exercises in patients with OA of knee

Often, people with osteoarthritis limit their activities due to pain and range of motion restrictions. This can result in decreased cardiovascular fitness, with associated functional decline and adverse effects on overall health. Thus, it is important that patients with osteoarthritis find ways to maintain cardiovascular fitness.

By improving endurance, we may be able to regain functions that have been lost, and reengage in enjoyable activities that had been discontinued. In addition to functional improvements, exercise has also been shown to decrease pain in osteoarthritis. For example, participating in aerobic exercises such as walking or cycling has been shown to decrease the pain related to arthritis and improves functional abilities.

Proctor and Kelly stated the response at articular cartilage to isometric exercises in which stress loads being placed upon articular cartilage were diffused and articular cartilage provided adequate lubrication thereby decreasing the pain and improving functional status.

Fitzgerald (2004) moderated the relationship between quadriceps strength and physical function in individuals with knee OA and stated physical function may be more severely affected by weakness at Quadriceps muscles.

Andrew M. Baye (2004) stated that isometric exercise protocols increases strength of muscles, but more at different angles.

Nichols DS (1994) Evaluated the effect of walking on pain and found a beneficial response. By improving endurance, we may be able to regain functions that have been lost, and re-engage in enjoyable activities that had been discontinued. In addition to functional improvements, exercise has also been shown to decrease pain in osteoarthritis.

For example, participating in aerobic exercises such as walking or cycling has been shown to decrease the pain related to arthritis and improves functional abilities.

Michael Olpin (2003) stated that Aerobic exercises increases thickness of cartilage, increases strength of connective tissues such as ligaments and tendons increase the size of skeletal muscle increases overall muscle strength and slows the rate of joint degeneration thereby decreasing the risk of injuries to locations such as knee

Fisher KM (1997) stated that subjects with OA knee had reduced muscle strength and functional capacity. Physical agents are devices using physical modalities to produce beneficial therapeutic effects. Heat, cold, pressure, light and even electricity have been used for thousands of years to accelerate healing and decrease pain. Heat therapy is applied to obtain analgesia, decrease muscle spasm, increase collagen extensibility and accelerate metabolic processes. Two forms of heat therapy are available. Superficial agents such as hot packs heat the skin and subcutaneous tissues, while deep heating agents such as therapeutic ultrasound may produce temperature elevations of $4\text{-}5^{0}$

Tseng BS (1995) stated that muscle mass motor unit number activation and synchronization that are highly related to strength had an indirect effect on endurance exercises and mitochondria concentration highly related to endurance capacity were increased and maintained by endurance training

Appropriate aerobic training program slows the rate of joint degeneration by improving the quality of cartilage and its substances. Thereby increases excessive loading on cartilage and strengthening of muscles, which serves as a main cause for the production of pain and improvement of function.

Comparison of functional status of WOMAC between controlled group and experimental group shows statistical significance between post-treatment groups.

When comparing the mean values, experimental group showed improvement than the controlled group. There exists a mean difference between control group and experimental group.

SUMMARY AND CONCLUSION

SUMMARY

In an effort to find out the efficacy between conventional therapy like ultrasound therapy, isometric knee exercises and self paced home exercises and aerobic exercise on improving functional abilities in early osteoarthritis of knee patients, 30 subjects were selected using purposive sampling technique and assigned in to two groups with 15 subjects each.

Control group was treated with ultrasound therapy, isometric exercises and appropriate home exercises for a period of 3 months and the experimental group were treated with aerobic exercise using treadmill along with the above said conventional treatment.

Pre-test and Post-test scores are recorded and analysis was done using independent 't' test which favored the alternate hypothesis.

The intra group analysis was done and results were analyzed using paired't' test, which favored the alternate hypothesis. Statistical analysis shows that there is significant improvement in functional abilities in experimental group based upon the **WOMAC** index scale.

CONCLUSION

Hence, it can be concluded that the aerobic exercise program in addition with the conventional therapy like ultrasound therapy, isometric knee exercises and home exercise programme for early osteoarthritic knee significantly improves the functional abilities.

SUGGESTIONS AND LIMITATIONS

- This study was very short term and therefore to make it more valid long term is necessary.
- Since the study has been done with smaller number of subjects further studies should be conducted with large group of population.
- Further study can be done along with PNF technique and other forms of exercises like closed and open kinetic exercises.
- Variation in climate, drugs, diet, personal habit, side of involvement, gender, age could not be controlled.

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APPENDIX -I

Subjective assessment

Name :

Age :

Sex :

Occupation :

Address :

Date of Admission :

Present complaint :

Past Medical History :

Personal history :

Objective Assessment

On Observation :

On Palpation :

On examination :

Measurement : WOMAC index scale

Progression chart : WOMAC index scale for improvement in functional ability.

S.no	Pre test value	Post test value

Signature of the physiotherapy student

APPENDIX – II

THE WESTERN ONTARIO AND MC MASTER UNIVERSITY (WOMAC) OSTEOARTHRITIS INDEX

The **WOMAC** categories are

Level of difficulty in performing the following functions

- Descending stairs
- Ascending stairs
- Rising from sitting
- Standing
- Bending to the floor
- Walking on flat
- Getting in/out of a car
- Going shopping
- Putting on socks
- Rising from bed
- Taking off socks
- Lying in bed
- Getting in/out of bath
- Sitting
- Getting on/off toilet
- Heavy domestic duties
- Light domestic duties

The **WOMAC** Parameters are

- 0-None, 1-slight, 2-moderate, 3-severe, 4-extreme

APPENDIX- III

INFORMED CONSENT FORM

TITLE: "A COMPARATIVE STUDY ON THE EFFECTIVENESS AEROBIC EXERCISE WITH CONVENTIONAL THERAPY ON IMPROVING FUNCTIONAL ABILITIES IN EARLY OSTEOARTHRITIC KNEE"

INVESTIGATOR: ……

PURPOSE OF THE STUDY:

I…….. , have been informed that this study will work towards achieving the near normal attainment of functional abilities and reduction in pain for early osteoarthritis knee for me and other patients.

PROCEDURE:

Each term of the study protocol has been explained to me in detail. I understand that during the procedure, I will be receiving the treatment for one time a day. I understand that I will have to take this treatment for four months.

I understand that this will be done under…… supervision. I am also aware that I have to follow the therapist's instructions as has been told to me.

CONFIDENTIALITY:

I understand that medical information provided in this study will be confidential. If the data are used for publication in the medical literature or for teaching purpose, no names will be used and on other literatures such as audio or video tapes will be used only with permission.

RISK AND DISCOMFORT:

I understand that there are no potential risks associated with this procedure, and understand that……. will accompany me during this procedure. There are no known hazards associated with this procedure.

REFUSAL OR WITHDRAWL OF PARTICIPATION:

I understand that the decision of my participation is wholly voluntary and I may refuse to participate, may withdraw consent at any time during the study.

I also understand that the investigator may terminate my participation in the study at any time after she has explained me the reasons to do so.

I …….. have explained to……. the purpose of the research, the procedures required and the possible risks and benefits, to the best of my ability.

…… ……

Investigator Date

I …….. confirm that …… has explained me the purpose of the research, the study procedure and the possible risks and benefits that I may experience, I have read and I have understood this consent to participate as a subject in this research project.

…….. ……

Subject Date

…….. …….

Signature of the witness Date